

CLAIMS

1 1. A composition for chemical-mechanical polishing, comprising:
2 at least one oxidizing agent; and
3 at least one abrasive particle having a surface at least partially coated by a
4 catalyst, the catalyst comprising a metal other than a metal of Group 4(b), Group 5(b) or
5 Group 6(b).

1 2. The composition of claim 1, wherein the oxidizing agent comprises a per
2 compound.

1 3. The composition of claim 1, wherein the oxidizing agent comprises ozone.

1 4. The composition of claim 1, wherein the oxidizing agent comprises an
2 agent selected from a group consisting of a metal salt, a metal complex, and any
3 combination thereof.

1 5. The composition of claim 1, wherein the oxidizing agent is selected from a
2 group consisting of hydroxylamine, a salt of hydroxylamine, and any combination
3 thereof.

1 6. The composition of claim 1, wherein the oxidizing agent ^{present} is in an amount
2 of from about 0.01 to about 30 weight percent relative to the composition.

1 7. The composition of claim 1, wherein the oxidizing agent ^{present} is in an amount
2 of from about 0.01 to about 10 weight percent relative to the composition.

1 8. The composition of claim 1, wherein the oxidizing agent ^{present} is in an amount
2 of from about 0.01 to about 6 weight percent relative to the composition.

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1 9. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a metal oxide.

1 10. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a material selected from a group consisting of alumina, ceria, germania, silica,
3 spinel, titania, an oxide of tungsten, zirconia, and any combination thereof.

1 11. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a metal oxide produced by a process selected from a group consisting of a sol-
3 gel process, a hydrothermal process, a plasma process, a fuming process, a precipitation
4 process, and any combination thereof.

1 12. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a resinous particle.

1 13. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a material selected from a group consisting of a polyacrylic acid, a
3 polymethylacrylic acid, a polymelamine, a particle of an ion exchange resin, and any
4 combination thereof.

1 14. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a plastic particle.

1 15. The composition of claim 1, wherein the at least one abrasive particle
2 comprises a material selected from a group consisting of a polyacrylic acid, a
3 polymethylacrylic acid, a polyvinyl alcohol, and any combination thereof.

1 16. The composition of claim 1, wherein an effective diameter of the at least
2 one abrasive particle is from about 30 to about 170 nanometers.

1 17. The composition of claim 1, wherein the at least one abrasive particle and
2 the catalyst on the surface thereof together are in an amount of from about 0.01 to about
3 50 weight percent relative to the composition.

1 18. The composition of claim 1, wherein the at least one abrasive particle and
2 the catalyst on the surface thereof together are in an amount of from about 0.01 to about
3 20 weight percent relative to the composition.

1 19. The composition of claim 1, wherein the at least one abrasive particle and
2 the catalyst on the surface thereof together are in an amount of from about 0.01 to about
3 10 weight percent relative to the composition.

1 20. The composition of claim 1, wherein the catalyst comprises a metal
2 selected from a group consisting of metals in Group 1(b) and Group 8.

1 21. The composition of claim 1, where the catalyst comprises a metal having a
2 standard oxidation potential of from about -0.52 to about -0.25 eV.

1 22. The composition of claim 1, where the catalyst comprises a metal having a
2 standard oxidation potential of from about -0.5 to about -0.4 eV.

1 23. The composition of claim 1, wherein the catalyst comprises a metal
2 selected from a group consisting of cobalt, copper, iron, and any combination thereof.

1 24. The composition of claim 1, wherein the catalyst comprises a material
2 selected from a group consisting of an oxide of the metal, an acetate of the metal, a
3 source of ionic metal, and any combination thereof.

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1 25. The composition of claim 1, wherein the metal is substantially insoluble in
2 the composition.

1 26. The composition of claim 1, wherein the catalyst coats from about 5 to
2 about 100 percent of the surface of the at least one abrasive particle.

1 27. The composition of claim 1, wherein the catalyst coats from about 5 to
2 about 80 percent of the surface of the at least one abrasive particle.

1 28. The composition of claim 1, wherein the catalyst coats from about 25 to
2 about 50 percent of the surface of the at least one abrasive particle.

1 29. The composition of claim 1, further comprising at least one other abrasive
2 that is free of a catalyst coating.

1 30. The composition of claim 1, wherein the other abrasive is in an amount of
2 from about 0.01 to about 30 weight percent relative to the composition.

1 31. The composition of claim 1, where in the other abrasive is in an amount of
2 from about 0.01 to about 20 weight percent relative to the composition.

1 32. The composition of claim 1, where in the other abrasive is in an amount of
2 from about 0.01 to about 10 weight percent relative to the composition.

1 33. The composition of claim 1, further comprising an additive selected from a
2 group consisting of a polish-enhancement agent, a stabilization agent, a surfactant, a
3 dispersion agent, a pH-adjusting agent, and any combination thereof.

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1 34. The composition of claim 33, wherein the additive is present in an amount
2 of from about 0.001 to about 2 weight percent relative to the composition.

1 35. The composition of claim 1, ~~wherein a pH level of the composition is from~~
2 about 2 to about 11. *was pH of*

1 36. The composition of claim 1, wherein a pH level of the composition is from
2 about 2 to about 8. *same as 35*

1 37. The composition of claim 1, wherein the oxidizing agent is present in a
2 prepared composition that lacks a catalyst-coated abrasive and comprises an oxidizing
3 agent.

1 38. The composition of claim 1, the composition sufficient for chemical-
2 mechanical polishing of a substrate surface having a feature thereon comprising a first
3 material selected from a group consisting of aluminum, copper, titanium, tungsten, any
4 alloy thereof, and any combination thereof. *obj doc not limit comp*

1 39. The composition of claim 38, the composition sufficient for chemical-
2 mechanical polishing of the substrate surface comprising a second material adjacent the
3 feature, the second material selected from a group consisting of tantalum, tantalum
4 nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination
5 thereof. *obj doc not limit comp*

1 ? 40. A method of polishing a substrate surface having at least one feature
2 thereon comprising a metal, comprising:
3 providing the composition of any one of claims 1-5, 9, 12-14, and 20-25; and
4 chemical-mechanical polishing the feature with the composition.

1 41. The method of claim 40, wherein said providing comprises combining the
2 at least one abrasive particle, the surface of which is at least partially coated with the
3 catalyst, with a prepared composition, the prepared composition lacking a catalyst-coated
4 abrasive and comprising an oxidizing agent.

1 (42) The method of claim 40, wherein the metal is selected from a group
2 consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any
3 combination thereof.

of the feature
- need to do the defined metal in compo

1 43. The method of claim 40, wherein the feature is adjacent a material selected
2 from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium
3 tungsten, tungsten, and any combination thereof.

1 44. The method of claim 40, wherein the chemical-mechanical polishing
2 comprises applying a pressure of from about 1 to about 6 pounds per square inch to the
3 feature.

1 (45) The method of claim 40, said method sufficient to remove the metal at a
2 rate of from about 100 to about 15,000 Angstroms per minute.

1 (46) The method of claim 40, said method sufficient to provide the substrate
2 surface at ~~from~~ about zero to about 40 percent within-wafer nonuniformity.

being

with

1 (47) The method of claim 40, said method sufficient to provide the substrate
2 surface at ~~from~~ about zero to about 12 percent within-wafer nonuniformity.

being

with

do it by hand

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1 (48). The method of claim 40, ~~said method sufficient to provide the substrate~~
2 ~~surface wherein any microscratch thereon produced during the chemical-mechanical~~
3 ~~polishing is less than about 20 Angstroms.~~ *of the sub surface* *see claim 49*

1 49. A substrate having a surface comprising at least one feature thereon
2 comprising a metal, said substrate produced by the method of claim 40.

1 (50). The substrate of claim 49, wherein the metal is selected from a group
2 consisting of ~~aluminum~~, ~~copper~~, ~~titanium~~, ~~tungsten~~, any alloy thereof, and any
3 combination thereof. *as the feature*

1 51. The substrate of claim 49, wherein the feature is adjacent a material
2 selected from a group consisting of ~~tantalum~~, ~~tantalum nitride~~, ~~titanium~~, ~~titanium nitride~~,
3 ~~titanium tungsten~~, ~~tungsten~~, and any combination thereof.

1 (52). The substrate of claim 49, the substrate surface ~~having~~ from about zero to
2 about 40 percent within-wafer nonuniformity. *was*

1 (53). The substrate of claim 49, the substrate surface ~~having~~ from about zero to
2 about 12 percent within-wafer nonuniformity. *was*

1 (54). The substrate of claim 49, wherein any microscratch on the substrate
2 surface produced during the chemical-mechanical polishing is less than about 20
3 Angstroms.